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(58) Field of search
F4U
Selected US specifications from IPC sub-class F24J

(54) Solar energy collector

(57) A solar energy collector is of tubular form and comprises an inner tube 2 which absorbs solar energy and through which a heat-collecting liquid can be circulated, and an outer transparent tube 1 of a material which transmits the incident solar radiation and traps the internally reflected solar energy. The outer tube 1, at least in lateral cross-section, has a fluted, corrugated or otherwise non-circular profile.

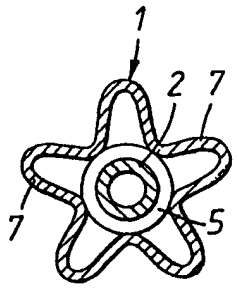

FIG. 2.

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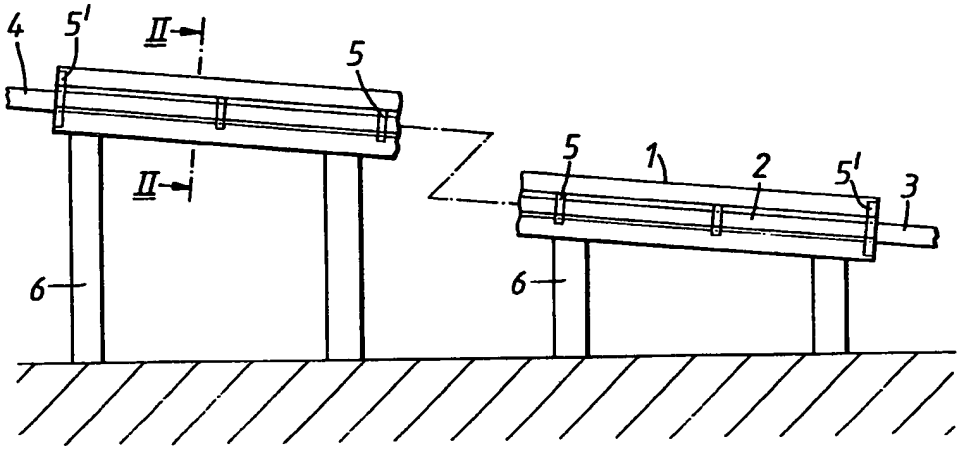

FIG. 1.

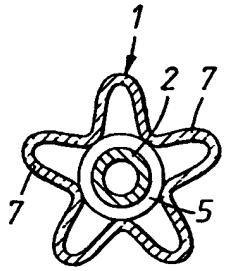

FIG. 2.

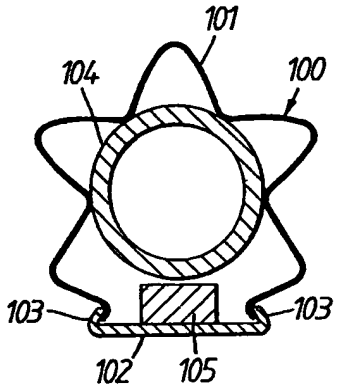

FIG. 3.

SPECIFICATION

Solar nergy collector

The invention relates to solar energy collectors of tubular form comprising an internal tube which absorbs solar energy and through which a heat-collecting liquid can be circulated, and an outer transparent tube of a material which transmits the incident solar radiation and traps the internally reflected solar energy so that the efficiency of heat transmission to the inner tube is greatly improved by the action of the so-called "greenhouse" effect.

Solar collectors are known with concentric inner and outer tubes of hollow cylindrical shape, and the disadvantage of such an arrangement is that the proportion of the incident radiation transmitted through the outer tube is highly dependent on the angle of incidence of the solar radiation. The principal object of the invention is to provide a tubular collector which is of increased efficiency in that the energy collection is less dependent on the angle of incidence of the solar radiation. Another object is to provide such a collector which can be designed to enable the tubular structure to be stationed and arranged without the necessity of providing expensive supporting structure or modification to a roof or other structure on which the collector is to be mounted.

According to the invention a tubular collector has an outer tube, of a transparent material which provides the greenhouse effect, which at least in lateral crosssection has a fluted, corrugated or otherwise non-circular profile.

Suitable materials for the outer tube are glass or an acrylic plastics such as is sold under the trade mark "Perspex". The outer tube may be of one-piece construction and of uniform cross-section along its length so that it can be produced as an extrusion, in which case it will be transparent throughout its full circumferential extent. Alternatively, the outer tube may be an assembly of at least two longitudinal components in which case one of these components may be transparent and present said non-circular profile whereas the other component provides a base surface suitable for mounting or supporting the complete collector assembly. The resilience and flexibility of the transparent component may be utilised to achieve snap- or clip-together assembly of the two components.

Th inner tube will normally have a black surface of low reflectivity, to provide maximum energy collection. It may be of blacken d copper to take advantage of the thermal conductivity th r of, but for a cost effectiv construction it is preferably provided by black polythen tubing. Th inner tube may be positioned within the outer tube, pr f rably concentrically, by means of a series of spacer discs which fit closely on the inner tube so that a sub-ass mbly of inner tube and spacer discs can be threaded into position within the outer tube. Alternatively, the inner tube may be located and supported by extruded lugs on the internal surface of the outer tube or, in the case of a two-component outer tube assembly, located by deformations providing the non-circular profile of the transparent component and supported on an insulating pad or pads on the base component of the outer tube assembly.

A solar energy collector in accordance with the invention may be a free-standing length with straight tubes, which may for example be laid alongside a swimming pool to be heated or on a roof, and it may be inclined to produce circulation of the heat-collection liquid passing through the inner tube by convection. Instead of such a gravity feed arrangement the liquid may be circulated by means of a pump, and for compactness the collector may be of sinuous or other non-linear shape, for example arranged in the form of a panel.

The invention will now be further described with reference to the accompanying drawings, which illustrate two embodiments by way of example and in which:

Fig. 1 is a side view of one embodiment;

Fig. 2 is a cross-section view on the line II-II in Fig. 1 to a larger scale; and

Fig. 3 is a view similar to Fig. 2 but of the other embodiment.

The solar energy collector shown in Figs. 1 and 2 comprises an outer tube 1 of transparent material which transmits incident solar radiation and has the characteristics which produce the greenhouse effect within the tube. A length of black polythene tube 2, such as is commonly used for water supply piping, extends within the tube 1 concentrically therewith. It extends at its ends beyond the tube 1, at 3 and 4, for connection in a circulating system for water to be heated by the collected solar energy.

As clearly shown in Fig. 2 the outer tube 1 is of fluted or lobed form in lateral cross-section, and it is of uniform section throughout its length so that it is conveniently manufactured as a plastics or glass extrusion. A suitable material for such an extrusion is the material sold under the trade mark Perspex. Alternatively the tube 1 may be of a suitable glass. The inner tube 2 is supported within the outer tube 1 by a series of spacer discs 5 and 5' which are a sliding fit in the tube 1 but fit closely on the tube 2. Thus during manufacture a sub-ass mbly of tub 2 and spac rs 5,5' can be thread d into th outer tube 1 to compl te the tubular collector ass mbly. The out r nd spac rs 5' substantially seal the nds of the outer tub 1 to retain therein the contained air heated by said gr enhous f- fect.

As shown in Fig. 1 the collector is of rigid free-standing form, and it is depicted as supported in an inclined disposition by spaced support pillars 6. This produces water circulation by convection, cool water to be heated entering the collector at 3 and leaving it at 4. During passage through the collector the water, which may be the contents of a swimming pool, collects thermal energy by heat exchange with the inner tube 2. The latter is heated not only directly by incident radiant energy but also by the heated air within the contained space by which the tube 2 is surrounded.

The cross-sectional profile of the outer tube 1 can be of any desired non-circular shape which will increase the surface area on which the solar radiation is incident as compared with a circular profile of the same overall diameter. A fluted or lobed profile as shown in Fig. 2, which illustrates a typical contour with five lobes such as 7, has been proved experimentally to be highly satisfactory.

The embodiment of Fig. 3 employs an outer tube 100 in the form of a two-component assembly consisting of a transparent component 101 and a flat base component 102. The component 101 is formed from a flat sheet of U/V resistant acrylic plastics material such as Perspex, which is longitudinally deformed or crimped to produce, in the assembly 100, the desired non-circular corrugated peripheral profile illustrated. The inherent flexibility and resilience of this material is utilised to provide clip-together assembly with the longitudinal edges of the component 101 clipping behind inwardly inclined edge flanges 103 of the base component 102.

In this embodiment the inner black polythene tube 104 is located within the assembly 100 by the deformations of the transparent component 101 and supported on an insulating pad 105, or a row of such pads, secured to the inner surface of the base component 102 of the assembly 100. The base component 102 is conveniently formed as a metal pressing or a plastics extrusion which need not be transparent and the characteristics of which, apart from providing the required rigidity, are unimportant.

A further advantage of a collector system in accordance with the invention is the ability to place reflectors externally of the tube arrangement to direct the solar rays and energy on to the tubular collector or collectors. This again substantially increases the total heat absorption and collection.

CLAIMS

1. A solar energy collector of tubular form comprising an inner tube which absorbs solar energy and through which a heat-collecting liquid can be circulated, and an outer transparent tube of a material which transmits the incident solar radiation and traps internally reflected solar energy, wherein the outer tube, at least in lateral cross-section, has a fluted, corrugated or otherwise non-circular profile.

2. A solar energy collector according to claim 1, wherein the outer tube is of glass or an acrylic plastics material.

3. A solar energy collector according to either one of the preceding claims, wherein the outer tube is of one-piece construction.

4. A solar energy collector according to claim 3, wherein the outer tube is an extrusion of uniform cross-section.

5. A solar energy collector according to claim 3 or claim 4, wherein the outer tube is transparent throughout its full circumferential extent.

6. A solar energy collector according to claim 1 or claim 2, wherein the outer tube is an assembly of at least two longitudinal components.

7. A solar energy collector according to claim 6, wherein one of said outer tube components is transparent and presents said non-circular profile, and the other outer tube component provides a base surface suitable for mounting or supporting the complete collector assembly.

8. A solar energy collector according to claim 7, wherein the resilience and flexibility of the transparent component is utilised to achieve snap- or clip-together assembly of the two components.

9. A solar energy collector according to any one of the preceding claims, wherein the inner tube has a black surface of low reflectivity.

10. A solar energy collector according to claim 9, wherein the inner tube is of blackened copper.

11. A solar energy collector according to claim 9, wherein the inner tube is provided by black polythene tubing.

12. A solar energy collector according to any one of claims 3 to 5, wherein the inner tube is positioned within the outer tube by means of a series of spacer discs which fit closely on the inner tube so that a sub-assembly of inner tube and spacer discs can be threaded into position within the outer tube.

13. A solar energy collector according to any one of claims 1 to 11, wherein the inner tube is located and supported by extruded lugs on the internal surface of the outer tube.

14. A solar energy collector according to any one of claims 6 to 8, wherein the inner tube is located within the outer tube by deformations providing the non-circular profile of the latter.

15. A solar energy collector according to claims 7 and 14, wherein the inner tube is located by said deformations of the transparent component and is supported on an insulating pad or pads on the base component of the outer tube assembly.

16. A solar energy collector according to any one of the preceding claims, constructed

as a free-standing assembly with straight inner and outer tubes.

17. A liquid heating installation including a solar energy collector in accordance with any one of the preceding claims.

18. A liquid heating installation according to claim 17, wherein the solar energy collector is in accordance with claim 16 and is inclined to produce circulation of the heat-collection liquid passing through the inner tube by convection.

19. An installation according to claim 17, including a circulating pump to circulate the heat-collecting liquid passing through the inner tube.

20. An installation according to claim 17, wherein the solar energy collector is of sinuous or other non-linear shape.

21. An installation according to claim 20, wherein the solar energy collector is arranged in the form of a panel.

22. A solar energy collector constructed and arranged substantially as herein particularly described with reference to Figs. 1 and 2, or Fig. 3, of the accompanying drawings.

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